WE CLAIM:

1. A transient light scattering shutter comprising:

first and second substrates;

a liquid crystalline material disposed between said first and second substrates, said material comprising a chiral liquid crystal; and

a voltage source coupled to said material and operative to provide:

a first electric field across said material to form a first transparent state,

a second electric field across said material to form a second transparent state, only one of said first and second electric fields being present across said material at a given time, and

a transition from one of said first and second electric fields to the other of said first and second electric fields by decreasing the voltage magnitude of one of said electric fields to zero volts and then increasing the voltage magnitude of the other of said electric fields from zero volts, said decreasing of voltage magnitude causing said material to form a transient light scattering state.

2. The transient light scattering shutter of claim 1 further comprising a heater operative to heat said liquid crystalline material.

3. The transient light scattering shutter of claim 1 further comprising a surfactant operative to increase transition speed between at least one of said first and second transparent states and said scattering state.

4. The transient light scattering shutter of claim 1 wherein said first and second substrates are comprised of a material selected from the group consisting of glass and plastic.

5. The transient light scattering shutter of claim 1 wherein said chiral liquid crystal is selected from the group consisting of cholesteric liquid crystal, nematic liquid crystal, and smectic chiral liquid crystal.

6. The transient light scattering shutter of claim 1 wherein said liquid crystalline material comprises a nematic liquid crystal and a chiral dopant.

7. The transient light scattering shutter of claim 1 wherein said liquid crystalline material is substantially polymer free.

8. The transient light scattering shutter of claim 1 wherein said chiral liquid crystal has a positive dielectric anisotropy.

9. The transient light scattering shutter of claim 1 wherein said voltage source comprises a DC bipolar voltage source.

10. The transient light scattering shutter of claim 1 wherein said second electric field has a polarity opposite said first electric field

11. A system operative to generate three-dimensional images comprising:

a multi-surface optical device comprising:

a plurality of transient light scattering shutters arranged in an array, each said shutter comprising first and second substrates and a liquid crystalline material disposed between said first and second substrates, said liquid crystalline material comprising a chiral liquid crystal, each said shutter having a transient light scattering state and a transparent state, and

a voltage source coupled to said shutters and operative to provide:

a first electric field across said material,

a second electric field across said material, only one of said first and second electric fields being present across said material at a given time, and

a transition from one of said first and second electric fields to the other of said first and second electric fields by decreasing the voltage magnitude of one of said electric fields to zero volts and then increasing the voltage magnitude of the other of said electric fields from zero volts; and

a first image projector operative to selectively project each image from a set of images onto a respective said shutter, said projected images together appearing as a three-dimensional image.

12. The system of claim 11 further comprising a heater to heat said material.

13. The system of claim 11 further comprising a surfactant operative to increase transition speed between at least one of said first and second transparent states and said scattering state.

14. The system of claim 11 further comprising a second image projector coupled to receive said projected images from said first image projector, said second image projector comprising optics to project said three-dimensional image at a location in space distant from said optical device, said projected three-dimensional image appearing to float in space.

15. The system of claim 11 further comprising a controller that comprises a computer processor, said controller operative to control the state of each said shutter, wherein one said shutter is in said transient light scattering state to receive and display said respective image, while the other said shutters are in said transparent state to allow viewing of said respective image on said one shutter.

16. The system of claim 15 wherein said controller is further operative to control said shutters during a plurality of cycles, each said shutter being in said transient light scattering state during a cycle different than the other said shutters.

17. The system of claim 11 wherein said first image projector projects each image of said set of images at a rate of no less than about 35 Hz.

18. The system of claim 11 wherein said shutters are equally spaced apart from each other.

19. The system of claim 11 wherein said shutters are logarithmically spaced apart from each other.

20. The system of claim 11 wherein said second electric field has a polarity opposite said first electric field.

21. A system operative to generate three-dimensional images comprising:

a multi-surface optical device comprising:

a plurality of transient light scattering shutters, each said shutter comprising first and second substrates and a liquid crystalline material disposed between said first and second substrates, each said shutter having a transient light scattering state and a transparent state, and

a voltage source coupled to said shutters and operative to apply first and second electric fields to said material, only one of said first and second electric fields having a non-zero value being present across said material at a given time;

a heater to heat said liquid crystalline material; and

a first image projector operative to selectively project each image from a set of images onto a respective said shutter, said projected images together appearing as a three-dimensional image.

22. A method of creating three-dimensional images using a transient light scattering shutter, said shutter comprising a liquid crystalline material, said material comprising a chiral liquid crystal, said method comprising:

applying a first electric field to said shutter to form a first transparent state;

decreasing said first electric field to zero volts to form a transient light scattering state; and

applying a second electric field to said shutter to form a second transparent state.

23. The method of claim 22 wherein said second electric field has a polarity opposite that of said first electric field.

24. The method of claim 22 further comprising heating said material to increase transition speed between at least one of said first and second transparent states and said scattering state.

25. The method of claim 22 wherein said liquid crystalline material further comprises a surfactant operative to increase transition speed between at least one of said first and second transparent states and said scattering state.

26. A method of creating three-dimensional images using a transient light scattering shutter, said method comprising:

transforming said shutter into a first transparent state;

transforming said shutter into a transient light scattering state; and

transforming said shutter into a second transparent state.

27. The method of claim 26 further comprising transmitting greater than about 85% of incident visible spectrum light while in said first transparent state.

28. The method of claim 26 further comprising transmitting less than about 1% of incident visible spectrum light while in said transient light scattering state.

29. The method of claim 26 further comprising transmitting less than about 0.5% of incident visible spectrum light while in said transient light scattering state.

30. The method of claim 26 further comprising transmitting less than about 0.1% of incident visible spectrum light while in said transient light scattering state.

31. The method of claim 26 further comprising transmitting greater than about 85% of incident visible spectrum light while in said second transparent state.

32. The method in claim 26 further comprising scattering light of a spectrum selected from the group consisting of the visible spectrum, the

ultraviolet spectrum, the near-infrared spectrum, and the infrared spectrum while in said transient light scattering state.

33. The method of claim 26 further comprising heating said shutter to increase transition speed between at least one of said first and second transparent states and said transient light scattering state.

34. The method of claim 26 wherein said shutter comprises liquid crystalline material and surfactant operative to increase transition speed of said material between at least one of said first and second transparent states and said scattering state.

35. A method of creating three-dimensional images using a transient light scattering shutter, said shutter comprising a liquid crystalline material, said method comprising:

heating said material;

transmitting greater than about 85% of incident visible spectrum light;

switching from a first transparent state to a transient light scattering state;

transmitting less than about 1% of incident visible spectrum light while in said transient light scattering state;

switching from said transient light scattering state to a second transparent state; and

transmitting greater than about 85% of incident visible spectrum light while in said second transparent state.

36. The method of claim 35 wherein said heating comprises heating said material to about 65° C.

37. The method of claim 35 wherein said liquid crystalline material further comprises a surfactant operative to increase transition speed between at least one of said first and second transparent states and said scattering state.

38. The method of claim 35 wherein said switching from a first transparent state comprises switching from a first transparent state to a transient light scattering state in about 0.34 msec.

39. The method of claim 35 wherein said switching from said transient light scattering state comprises switching from said transient light scattering state to said second transparent state in about 0.45 msec.

40. A method of creating three-dimensional images using a transient light scattering shutter, said shutter comprising a liquid crystalline material disposed between first and second conducting layers, said material comprising a chiral liquid crystal, said method comprising:

applying zero voltage to said first conducting layer;

applying to said second conducting layer a positive voltage operative to make said material transparent;

decreasing said positive voltage at said second conducting layer to zero volts to cause said material to form a transient light scattering state;

holding said zero volts at said second conducting layer; and

decreasing the voltage at said second conducting layer from zero volts to a negative voltage operative to make said material transparent.

41. The method of claim 40 wherein said holding comprises holding said zero volts at said second conducting layer for about two milliseconds.

42. A method of creating three-dimensional images using a transient light scattering shutter, said shutter comprising a liquid crystalline material disposed between first and second conducting layers, said material comprising a chiral liquid crystal, said method comprising:

applying zero voltage to said first conducting layer;

applying to said second conducting layer a positive voltage operative to make said material transparent;

increasing said zero voltage at said first conducting layer to a positive voltage substantially equal to said positive voltage at said second conducting layer to cause said material to form a transient light scattering state;

decreasing said positive voltage at said second conducting layer to zero volts; and

decreasing said positive voltage at said first conducting layer to zero volts to cause said material to form a transient light scattering state.

43. A method of creating three-dimensional images using a transient light scattering shutter, said shutter comprising a liquid crystalline material disposed between first and second conducting layers, said material comprising a chiral liquid crystal, said method comprising:

applying zero voltage to said first conducting layer;

applying to said second conducting layer a positive voltage operative to make said material transparent;

decreasing said positive voltage at said second conducting layer to zero volts to cause said material to form a transient light scattering state;

holding said zero volts at said second conducting layer; and

increasing the voltage at said second conducting layer from zero volts to said positive voltage.

44. Apparatus for creating three-dimensional images using a transient light scattering shutter, said apparatus comprising:

means for transforming said shutter into a first transparent state;

means for transforming said shutter into a transient light scattering state; and

means for transforming said shutter into a second transparent state.

45. The apparatus of claim 44 further comprising means to increase transition speed between at least one of said first and second transparent states and said scattering state.

46. Apparatus for creating three-dimensional images, said apparatus comprising a liquid crystalline material, said apparatus comprising:

means for heating said material;

means for transmitting greater than about 85% of incident visible spectrum light;

means for switching from a first transparent state to a transient light scattering state in less than about 1.56 msec;

means for transmitting less than about 1% of incident visible spectrum light while in said transient light scattering state;

means for switching from said transient light scattering state to a second transparent state in less than about 2.73 msec; and

means for transmitting greater than about 85% of incident visible spectrum light while in said second transparent state.